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botany or agriculture in the botanical instruction; (3) the biological grouping of subjects; (4) the holding of the interest of the students, *i. e.*, the finding of the effective point of contact for botany with students who are looking for practical values. No formulation of the value of botany can be made until these problems have been settled. The time is now ripe for a well-organized investigation, to be followed by a statement of well-established conclusions.

A full report of the meeting will be issued in pamphlet form early in May. This will be sent to the members of the federation. Any one may obtain copies by applying to the secretary.

C. R. MANN,
Secretary

THE UNIVERSITY OF CHICAGO

THE AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE
SECTION F (ZOOLOGY)

THE vice-presidential address at the Baltimore meeting was delivered by Professor E. B. Wilson. It was published in SCIENCE, January 8, 1909.

The secretary has received abstracts of papers read as follows:

Brood-protection and Sexual Dimorphism among Echinoderms: HUBERT LYMAN CLARK, Harvard University.

The large number of echinoderms now known (about fifty) which protect or care for their young in some way show great diversity in the method used. The eggs may develop outside the body of the parent or more rarely within the body-cavity or in special reproductive cavities. If developed outside the body, the young may become attached to some part of the parent, or be sheltered among her spines or covering plates, or simply be brooded beneath her ventral surface. If developed within the parent, the young may swim about freely in the body-cavity, or more rarely undergo their development in the reproductive organs, which are thus practically uteri.

Among all these brood-protecting species, however, there seem to be only half a dozen (about twelve per cent.) which occur in tropical waters, while more than sixty per cent. are found in Antarctic or South Temperate seas.

Only four species, and these all from between 30° and 60° S. latitude, show any marked sexual dimorphism. In one, an ophiuran, the male has only five arms, the female, six to eight (Koehler). In another, a holothurian, the development of a peculiar brood-chamber in the dorsal integument

distinguishes the female. The third is a spatangoid in which the lateral petals of the female are much broader and deeper than those of the male and serve as brood-pouches. The fourth is a clypeastroid, recently discovered in the Australian collections of the "Thetis," in which the abactinal area of the female is deeply depressed to form a horseshoe-shaped brood-chamber, wholly wanting in the male.

Notes on the Eggs of the Anura of Ithaca, N. Y.: ALBERT H. WRIGHT, Cornell University.

Eight species of Anura are found at Ithaca, N. Y., namely: *Rana sylvatica*, *Hyla pickeringii*, *Rana pipiens*, *Bufo lentiginosus americanus*, *Rana palustris*, *Hyla versicolor*, *Rana clamitans* and *Rana catesbiana*.

The first five species appear from hibernation and spawn under a maximum air temperature of 43–50° F.; the last three delay until the maximum reaches 70° F. or more. The first five usually breed from the last of March until the middle of June; the last three, from the last of May into August. All but two species, *Bufo l. americanus* and *Rana clamitans*, occupy four or five weeks for the spawning period. The exceptions may require two or three months. The number of eggs may vary from 800 in *Hyla pickeringii* to 20,000 in *Rana catesbiana*.

The eggs of three species, *Hyla versicolor*, *Rana clamitans* and *Rana catesbiana*, float more or less at the surface of the water; the eggs of the other five are submerged. The five species with submerged eggs are the first to breed. They deposit eggs with firm jelly envelopes, several eggs appearing at an emission except in *Hyla pickeringii*, where only one appears at an emission. The three with buoyant eggs breed after May 25. They deposit at the surface masses or films of eggs with loose jelly envelopes, several eggs being deposited at an emission. The best differential egg characters are: the manner of deposition, the nature of the jelly envelopes, the color of the vitellus, the diameters of the vitellus and jelly envelopes, the number of eggs and the season of deposition.

Factors Determining the Movement of Melanin Pigment Granules: OSCAR RIDDLE, University of Chicago.

Movement of these particles from one part of the cell plasma to another, and from one cell to another, is probably determined either by the solubility properties or by the electrical state of the granules. Author obtained no evidence of solubility. The granules are, however, definitely proven to be colloidal bodies bearing a negative

electrical charge—the granules unflinchingly moving toward the anode when placed in an electrical field of light intensity. The author thinks this explains not only the movements of independent granules, but the movements of some chromatophores as a whole—as for example the skin chromatophores of lower vertebrates and the retinal pigment of arthropods and vertebrates. And, finally, this fact is of very considerable importance in a consideration of the physiology of color inheritance.

The Rate of Digestion in Cold-blooded Vertebrates in Relation to Temperature: OSCAR RIDDLE, University of Chicago.

By the use of Mett's tubes and a constant temperature tank, information was sought and obtained from cold-blooded vertebrates on the following points: (1) A definite measure of the rapidity of digestion, (2) comparison of this rate in fishes, amphibians and reptilia, (3) seasonal variations in digestive power, (4) a direct and definite measure of the effect of raising or lowering the temperature of the animals, on their rate of digestion, (5) the temperature coefficients of digestion in these animals.

It appears that a gradual loss of digestive capacity has occurred in the amphibia and reptilia during their evolution; and the bearing of this fact on the development of warm-bloodedness in the vertebrata seems to merit attention.

The Hyobranchial Apparatus of Typhlotriton: WM. A. HILTON, Cornell University, Ithaca, N. Y.

The hyobranchial skeleton of *Typhlotriton spelæus* in the adult resembles *Spelerpes* rather than members of the family *Desmognathidae* in which it has been placed. The hyobranchial skeleton of the larva resembles *Spelerpes* much more than the larva of *Desmognathus*. Like *Spelerpes* it has but three branchial arches, while *Desmognathus* has four.

Typhlotriton is a cave form, but from its eyes and other structures it seems to have much more recently come to such an environment than *Typhlomolge*. The hyobranchial apparatus of *Typhlotriton* larva is almost the same as that of the supposed adult, but possible larval form of *Typhlomolge*.

A series of apparently related species beginning with those living in caves only to a slight degree and ending with those best adapted to a subterranean life, is as follows: (1) *Spelerpes longicaudus*, (2) *Spelerpes maculicaudus*, (3) *Typhlotriton spelæus*, (4) *Typhlomolge rathbuni*.

Some Egg-laying Habits of Amphitrite: JOHN W. SCOTT, Kansas City, Mo.

(1) The egg-laying reflex of *A. ornata* is closely associated with the time of spring tide, the height of any given period of egg-laying always occurring within three days of the time of new or full moon. In early summer the period of sexual activity tends to occur after, in late summer before, spring tide. (2) Eggs and sperm float free in the body-cavity, and are usually in various stages of development. Ripe eggs show the metaphase of the first maturation spindle, and eggs in this stage have a greater density than unripe eggs. It is entirely probable that the apparent selection of ripe and rejection of unripe eggs by the nephridia is due to the different effects produced by nephridial currents upon bodies of differing densities.

Bilateral Symmetry in the Development of the Primary Septa of a Living Coral: J. W. MAVOR, Cambridge, Mass.

The usual bilateral symmetry in the development of the first six pairs of mesenteries is shown to occur in *Agaricia fragilis*. The six primary septa are found to be arranged about a plane of bilateral symmetry which is the same as that for the soft parts, and the exosepta are found to arise in bilateral pairs. The bilateral symmetry of the primary septa is found to persist in later stages with well developed epitheca and exosepta. The arrangement of the primary septa in *Agaricia* is different from that in *Siderastræa radians* as described by Duerden, but agrees with that in *Lophophyllum proliferum* as described by the same author.

Autotomy of the Hydranth of Tubularia: MAX MORSE, College of the City of N. Y.

Hydroids commonly absorb their hydranths when placed under artificial conditions. *Tubularia* is an exception, and pinches off the hydranth entirely from the stem. Later it regenerates a new hydranth. There is no disintegration of the cells until after the hydranth has fallen off. Temperature is the active factor in inducing the process; hence *Tubularia* naturally occur fully developed at certain definite periods.

Rôle of the Nerve System in Regeneration in Earthworm and Newt: A. J. GOLDFARB, Columbia University.

The accumulated evidence points to the conclusion that early embryos and larvæ can regenerate missing organs independently of morphogenic influences exerted by or through the nerve system. Concerning the rôle of the nerve system in adults

there is a great diversity of opinion. Experiments upon the earthworm were intended to reexamine the evidence with regard to the influence of the nerve cord on the regeneration of the head. Removal of the cord from the amputated end, for a distance sufficient to prevent innervation of that end, did not inhibit the formation of a functional head.

After determining the number and origin of the nerves supplying the rear limbs and different levels of the tail in the common newt, *Diemyotelus viridescens*, the cells from which these nerves arise were totally destroyed, in both the nerve cord and the ganglia. The cord in the adjoining regions was also destroyed to prevent secondary innervation. Subsequent examination of serial sections established the fact that both the tail and the rear limbs replaced missing parts in the total absence of nerve stimuli, that where under certain special conditions regeneration did not take place, the motor and sensory functional nerves at the amputated end were unable to stimulate the organ to regenerate the lost parts.

Nuclear Components of the Sex-cells of Cockroaches: MAX MORSE, College of the City of New York.

The author presented evidence for: (1) A sex-difference in the chromosomes of the ovary and testis cells, (2) reduction by parasynapsis involving two longitudinal divisions of the chromosomes, (3) the absolute distinction between plasmosome (achromatic nucleolus) and the odd chromosome, contrary to Moore and Robinson, Foot and Strobell, Arnold and others, (4) the individuality of the chromosomes.

Featherless Fowls: R. H. CHAPMAN, U. S. Geological Survey.

The writer called attention to an abnormal condition in chickens seen by him at Delhi, N. Y., during summer and fall of 1908. Some 500 birds of the barred Plymouth Rock breed were incubator hatched between June 5 and 20. Of this number about ten per cent. failed to develop normally—a small number were deformed or became "crazy" after a short time and all (of the ten per cent.) failed in bodily growth and normal feathering. By November 10 all of the naked birds had died. The eggs had come from a farm in the vicinity and the parent birds had been inbred for four or five years.

On the Skull and the Brain of Triceratops: O. P. HAY, Washington, D. C.

This paper questions the correctness of the accepted view that the frill of *Triceratops* has as

its median element the parietal bone. This median element is either a greatly developed nuchal scute or coalesced supratemporal bone. The parietal is that bone which has hitherto been called the supraoccipital. The foramen that Marsh called the pineal foramen, by others the postfrontal foramen, is properly the coalesced supratemporal foramina.

On the Intellect of Animals: ALEXANDER PETRUNKEWITCH, Short Hills, N. J.

Since man can judge of the thinking processes in animals from their actions only, the chief problem is to establish the relation between thought and actions. Conclusions from actions as to presence or absence of reasoning are often based on too little evidence and admit different interpretations. The chief difference in actions of man and those of animals is usually found in the absence of choice in animals. The conclusion which the author supported by new evidence is that reasoning has been gradually developed with the progress of evolution and is certainly to be found in its simpler forms in some higher mammals at least.

Olfactory Nerve, Nervus Terminalis and Preoptio Sympathetic System in Amia calva: CHAS. BROOKOVER, Buchtel College.

The olfactory nerve arises from an ectodermal placode in *Amia*. Nuclei migrate from the placode along the olfactory nerve toward the brain. Some of these nuclei produce sheath cells of the olfactory nerve. Others of the nuclei become enlarged, produce a ganglion two days after hatching, and when the fish is 50 mm. long number about two hundred and fifty cells. Allis homologized this ganglion and its nerve with Pinkus's nerve in *Protopterus*. There are nearly a thousand cells in each adult nasal capsule of *Amia*. They show Nissl bodies. Some are multipolar nerve cells. It is suggested from their relation to the blood vessels that these ganglion cells are vaso-motor in function. About fifty coarse fibers differing from olfactory fibers are found entering the olfactory bulbs. Other fibers extend posteriorly ventrally of the brain. A nervus terminalis is present in *Lepidosteus* and teleosts.

Nerve fibers with ganglion cells inside the cranial cavity were found entering from the profundus branch of the fifth nerve. These fibers innervate the paraphysis and blood vessels of the meninges of the forebrain. Some of the fibers extend forward as far as the nerve of Pinkus (nervus terminalis) and may form a sympathetic

connection with the latter nerve. The pineal stalk is innervated by a bundle of about thirty fibers connecting with the brain just caudad of the habenular body. Intravital methylene blue preparations of the stalk of the epiphysis show ganglion cells with an interlacing plexus of fibers very similar to the sympathetic innervation of the walls of the intestines of vertebrates.

Effects of Brachycephaly and Dolichocephaly upon the Teeth of Man: RAYMOND C. OSBURN, Barnard College, Columbia University.

A study of various types of skulls to show the variations in the dental arch, and especially in the teeth themselves. The principles which have been stated by Professor H. F. Osborn (*Bul. Am. Mus. Nat. Hist.*, Vol. XVI., art. 7) as operating in various groups of lower mammals are here shown in man within the limits of a single species.

Some Noteworthy Additions to the Bryozoan Fauna of our Atlantic Coast: R. C. OSBURN, Columbia University.

A series of lantern slides showing various families, genera and species of Bryozoa new to our east coast fauna. A preliminary report of certain of the more striking forms collected by the author at the Tortugas, Beaufort and Woods Hole stations.

Fission and Regeneration in Sagartia luciae: D. W. DAVIS, Sweet Briar College, Va.

The sexually derived, undivided individual in *S. luciae* is probably a regular hexamerous form with six pairs of complete mesenteries. Of these, two pairs situated at opposite ends of the major transverse axis are directives and each directive pair is associated with a siphonoglyph. A secondary cycle, of incomplete mesenteries arranged in pairs, alternates with the pairs of the first cycle. A third cycle is usually present, and even a fourth may be represented. Longitudinal division is so common that such undivided animals are rare, and fission followed by regeneration plays an important part in the life-history. Fission occurs, almost without exception, in endocœls and, in about two thirds of the cases examined, in complete endocœls. The fission-plane shows a decided tendency to pass at right angles with the major transverse axis, producing bilaterally symmetrical pieces, but with little regard to an accurate halving of the dividing animal.

In regeneration, from eight to ten complete mesenteries are formed, the precise number depending upon the complete or incomplete character of the mesenteries at the boundaries of the old part. The new mesenteries are formed in a

characteristic succession not harmonizing with an *Edwardsia* type of development but corresponding to the order described by the Hertwigs for two (possibly regenerating) specimens of *Adamsia*.

Reactions of the Dogfish to Chemical Stimuli: R. E. SHELDON, University of Chicago.

The smooth dogfish, *Mustelus canis* (Mitch.), was tested over the entire body surface, mouth, spiracle and nostrils with acid, saline, alkaline, sweet and bitter substances. The fish was found to be very sensitive over the entire surface to acids and alkalis in very dilute solution. It is less sensitive to salts and bitter substances and does not react at all to sweet solutions. The general body surface, particularly the fins, are more sensitive to alkalis and salts than is the mouth; both are equally sensitive to acids, while the mouth is the more sensitive to bitter substances. When the spinal cord is destroyed no reactions are obtained from the caudal part of the body, showing that the lateral line nerves have nothing to do with these reactions. When the cord is severed from the brain, the caudal part of the animal is more sensitive than before to chemical stimuli. There is no spinal shock after section of the cord. The nostrils are very sensitive to alkalis, acids, salts and bitter solutions. Section of the olfactory crura and different rami of the trigeminus nerve showed that this sensitiveness is due to the maxillaris nerve rather than the olfactory. Parts of the body were overstimulated for tactile response, after which they could always be stimulated chemically. When any region was overstimulated for any given chemical, as an acid, it rarely responded to tactile stimuli, although it usually responded to other chemical stimuli, as a saline or alkaline solution. When cocaine was applied to the skin, tactile response disappeared before chemical. Among the different chemical senses, bitter disappeared first. This sensitiveness to chemical stimuli is due almost exclusively to the nerves of general sensation, not at all to the olfactory nerve and very little, if any, to the gustatory nerves.

Chondrocranium of an Embryo Pig: CHAS. S. MEAD, New York City.

The study of the chondrocranium of *Sus* is of value not only in assisting us to understand the structure of the adult skull in this form, but also on account of its bearing on the general morphology of the mammalian cranium. Owing to its relatively low position in the ungulate series, we would expect many primitive characters to be retained in its cartilaginous cranium, and indeed

this is the fact, for a number of reptilian characters are present.

The notochord, near the middle of its passage through the skull, dips beneath the basal plate and is connected with the dorsal wall of the pharynx in two places. The cartilages which will later form the ear-bones are of the type common to the mammals at this stage of development. A foramen nervus abducens is present. It is in the same position as the similarly named foramen in the reptiles, but the two are not homologous, that in *Sus* being secondary. The cranial cavities in the reptiles and mammals are not strictly homologous, but the cavity in the mammals is larger morphologically than that of the reptiles and has been increased by the addition of the reptilian cavum epiptericum. Vestiges of the primitive side wall of the cranium are found in *Sus*. Taken as a whole, the chondrocranium of the pig is that of a generalized mammalian type. It shows certain specialized characters such as the narrowed anterior portion of the basal plate, the large size of the ear capsules, and the secondary foramen nervus abducens, but these are less striking than the secondary characters of *Echidna*, *Talpa*, *Lepus* or the Primates.

Placentation of an Armadillo: H. H. LANE, State University of Oklahoma.

The placentation of the Edentates has not been thoroughly studied and only a few observations have been recorded. A female nine-banded armadillo (*Tatu novemcinctum*) in captivity gave birth to four young, and an examination of the deciduate placenta revealed some novel features. There was a complete fusion of the four chorionic vesicles into one. The four amnia were united so as to divide the chorionic cavity into four longitudinal chambers, each with a single umbilical cord attached to its wall. In this specimen the placenta is intermediate in form between the zonary and the discoidal. The villi are present in a broad band surrounding the chorionic vesicle, which is barrel-shaped and has thin membranous ends devoid of villi. The villous band is made up of two disc-shaped areas of very long villi, separated by two bands of very short villi. Each of the two areas with long villi has on its amniotic surface the points of attachment of two umbilical cords. There is no indication of a decidua capsularis. This highly developed placenta would indicate that the armadillo is a specialized form, instead of a primitive type; and if this character is of systematic value, the Edentata are to be regarded as a heterogeneous group and not a natural one.

Cestodes in Flesh of Marine Fishes: EDWIN LINTON, Washington and Jefferson College.

The only common food fishes found to harbor cestodes habitually in the flesh are the butterfish (*Rhombus triacanthus*) and the harvest fish (*R. paru*). The cestode is *Otobothrium crenacolle*. The adult stage has been found in the hammer-head shark (*Sphyrna zygaena*) in New England waters, in the sharp-nosed shark (*Scoliodon terrena*) at Beaufort, and in the cub shark (*Carcharhinus platyodon*) at Tortugas.

In the encysted stage it has been found in twelve species of Woods Hole fishes, in thirteen species of Beaufort fishes and in three species of Bermuda fishes. In all these, with the exception of the butterfish and harvest fish, the parasites were confined to the body cavity where they were encysted on the viscera or in the walls of the stomach and intestine. In the summer of 1908, butterfish to the number of 715 were examined and cysts were found in all but 22. Twelve harvest fish were examined and numerous cysts were found in each. The paper discusses the exceptional position of these cysts in the butterfish and the unusually high percentage of affected fish.

Systematic Relations of the Urodela as Interpreted by a Study of the Sound-transmitting Organs: H. D. REED, Ithaca, N. Y.

This study is the result of the curiosity aroused by the apparent conflicting statements regarding the systematic position and relationships of the various groups of Urodela. Believing that the limits and position of some of the larger groups have been based upon structures which are either affected by environment or negative in their character, and, furthermore, believing that the classification of any group is sounder when based upon results gained from a comparative study of several organs or systems, it was decided to place in evidence a comparative study of the sound-transmitting organs already under investigation with another end in view.

Cryptobranchus is the most generalized. The Ambystomidae are intermediate between *Cryptobranchus* and all other groups. The Plethodontidae and Desmognathidae are departures from the *Ambystoma* stem while from these the Sirenidae and *Amphiuma* seem to be degenerated. *Diemictylus* and *Triton* are identical with regard to these ear structures and differ from all others. They are to be considered the most specialized. Between *Diemictylus* and *Triton* on the one hand and the Ambystomidae on the other *Salamandra* stands intermediate, resembling more strongly the Ambystomidae.

Morphology of the Sound-transmitting Apparatus in the Amphibia: B. F. KINGSBURY and H. D. REED, Cornell University.

Study of serial sections and models of representatives of eight families and seventeen genera of tailed amphibia has shown that there are two skeletal structures fitting in the fenestra vestibuli. The first of these, which we designate as the columella, is connected with the cephalic edge of the fenestra when a connection exists between the ear capsule and columella at all. It bears a more or less well developed process primarily connected with the squamosal bone in *Necturus*, *Proteus* and *Cryptobranchus*. In adult *Ambystoma*, *Amphiuma* and *Siren* there is a secondary connection of this process with the quadrate. The second element, which we designate as the operculum, has no skeletal connections but affords attachment to a muscle, the m. opercularis of Gaupp. When attachment of this element to the ear capsule occurs it is with the caudal margin of the fenestra. The cephalic end of the operculum is included within the lips of the fenestra vestibuli while in its caudal extent it protrudes. This is the type found in *Diemictylus* and *Triton*. In the larval *Ambystoma*, at transformation, the columella becomes incorporated with the ear capsule while from the latter the operculum is cut out essentially by an extension of the fenestra vestibuli. In the adult of some forms, e. g., *Diemictylus* and *Triton*, only the operculum is present while in others, e. g., *Ambystoma* and *Salamandra*, both elements are represented. In still other forms such as *Plethodon* and *Gyrinophilus* both columella and operculum seem to be present and very closely associated, although the developmental stages upon which the final explanation of the morphologic relations depends have not yet been examined.

On the Effects of Centrifugal Force on the Development of the Eggs of the Frog and Sea Urchin: J. F. McCLENDON, University of Missouri.

The unsegmented egg of *Rana pipiens* subjected to a centrifugal force = $2,771 \times$ gravity for several minutes, is separated into three layers as follows: a centrifugal yolk layer containing the black pigment granules, an intermediate protoplasmic layer (containing the nuclear elements) and a centripetal fatty layer colored with yellow pigment. Egg material was centrifuged in mass and enough of each layer obtained for certain chemical analyses. Morgan found in 1902 that a certain amount of centrifuging prevented the cen-

trifugal layer from developing. When subjected to more centrifuging no part of the egg develops. When the centrifuged egg partially develops, the centripetal and intermediate layers are more or less mixed in the early cleavage, so I have in the following tables added together the analyses of the centripetal and intermediate layers under the name of the former. Table I. gives the per cent. of water (W.) and solids (S.) in the layers. Table II. gives the per cent. of extracts (E.E. = ether extract, A.E. = alcohol extract, W.E. = water extract) and residue (R.) in the solids. Table III. gives the per cent. of phosphorus (P.) in the extracts and residue. Cp. = centripetal and Cf. = centrifugal layer.

TABLE I.

Layer	W.	S
Frog: Cp.	74	26
Cf.	48	52
<i>Arbacia</i> : Cp.	88	12
Cf.	79	21

TABLE II.

Layer	E.E. + A.E.	W.E.	R.
Frog: Cp.	51	34	15
Cf.	30	10	60
<i>Arbacia</i> : Cp.	49	20	31
Cf.	38	10	52

TABLE III.

Layer	P. in E.E. + A.E.	P. in W.E.	P. in R.
Frog: Cp.	0.018	1.0	0.4
Cf.	0.54	1.2	1.3
<i>Arbacia</i> : Cp.	2.36	17.0	3.2
Cf.	2.74	13.0	1.6

In Tables I.-III. it is observed that there are great differences between the composition of the two layers, and this is correlated with their different capacity for development.

If the egg of *Arbacia* be centrifuged it is separated first into two and later into four layers. By freezing and crushing the eggs and centrifuging in mass I obtained two layers corresponding to the two first obtained in the entire egg. Centrifugal force has little effect on the development of the egg of *Arbacia*. By inspecting the last two lines in Tables I.-III. it will be noticed that there is very little difference between these two layers in composition, and this is correlated with the fact that there is little difference in their capacity for development.

Centrifugal force causes flattening of the mitotic

figures in the frog's egg in the direction of the force. This effect of the force is due apparently to compression of the alveolar framework of the egg, on one side by the fatty layer and on the other by the yolk layer.

Regeneration and Growth in Fishes: G. G. SCOTT, College of City of New York.

The caudal fin of 117 *Fundulus heteroclitus* of sizes varying from 4.57 cm. to 9.73 cm. long was removed. Fins of the younger fishes (shorter) regenerated proportionately more than the older (longer). In fact the curve representing the proportional amount of regeneration in fishes of different ages (lengths) was regularly descending, reminding one of curve of growth established by Minot. One might conclude that regeneration paralleled growth, i. e., that the power of regeneration is greater in the young. On closer examination we find that each fish (regardless of length) regenerated about 0.6 cm. The following explanation is offered: Regeneration of new fin tissue is due to proliferation outwards in a linear direction of new cells arising from the division of cells exposed by the line of amputation. A fish 5 cm. long contains same sized cells as a fish 10 cm. long and the probability is that the power of proliferation is about the same in the cells of fishes of each size—provided that the cells are at the same relative level in each case. When the amputation was made the author endeavored to have line of removal at same relative place in all specimens. Evidence as to the similar powers of regeneration residing in cells of same level independent of size (age) is shown by the fact that actual regeneration outwards in a linear direction is same in fishes of all sizes. This indicates that regeneration is a process independent of general growth processes. It comes into play under abnormal conditions.

The Early Development of Neurofibrillæ and Nerve Function: HANSFORD M. MACCURDY, Alma College, Alma, Mich.

With the purpose to find the earliest stage at which neurofibrillæ may be discovered in the developing nerve cells and the relation between their first appearance and the establishment of conduction paths as evidenced by the earliest normal movements and reactions to external stimuli, observations were made on the larvæ of *Rana* and *Amblystoma*. Neurofibrillæ are present in the earliest optic nerve fibers and in the retinal elements long before they can perform their regular function. That they are also present in early fiber tracts of the neural tube, preceding normal

movements seems amply demonstrated, but further confirmation is to be sought. It appears altogether probable that the neurofibrillæ arise practically contemporaneous with the outgrowth of the nerve fiber.

Regeneration in the Brittle-star Ophiucoma pumila, with Reference to the Influence of the Nervous System: SERGIUS MORGULIS, Cambridge, Mass.

1. Is the presence of the nerve essential for the regeneration of the arms in the brittle-star *Ophiucoma pumila*? To answer this question the radial nerve was injured by a red-hot needle near the disc, and then the arm was cut off about the middle of its length. As a control experiment another arm in the same specimen was also cut on at the middle, but its radial nerve was left intact. It was found that in the course of thirty days the arms with radial nerve intact had all regenerated normally, while those with the radial nerve injured produced only a very minute stump of new tissue. If, however, the arm broke off at the place where the nerve was injured—as occasionally happened soon after the operation—no tissue was regenerated from such an exposed surface, although arms in which the radial nerve was intact, even in the same animal, did regenerate.

2. What is the relation of the rate of regeneration to the "level" at which the arms are cut off? It was found that arms cut off at the base or at the middle regenerate much faster than those cut off at the tips.

3. What is the relation of the rate of regeneration to the number of arms removed? The removal of different numbers of arms influences the rate of regeneration of the lost arms only to a small extent; the rate of regeneration when four or five arms are removed is somewhat greater than when one, two or three arms are removed; but this correlation between the degree of injury and the rate of regeneration is not of the nature of a close parallelism.

MAURICE A. BIGELOW,
Secretary

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SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

THE 432d regular meeting of the society was held April 6, 1909, President Hough in the chair. The following program was presented:

New Chapters in the History of the Coconut Palm: Dr. O. F. COOK.